

IN THE CLAIMS

Please cancel claims 13 and 40 and amend claims 1, 4 and 8 as indicated.

1. (Currently Amended) A semiconductor wafer cleaning formulation, comprising by weight between about 1% and about 21% fluoride source, between about 20% and about 55% organic amine, ~~between about 0.5% and about 40% carboxylic acids and imines,~~ between about 23% and about 50% water, ~~and a metal chelating agent,~~ and between about 0.5% and about 40% of a nitrogenous component including a compound of the formula $\text{COOH-CH}_2\text{-NRR}'$, wherein each of R and R' is independently selected from the group consisting of hydrogen, alkyl, aryl, and carboxylic acids.

2. (Original) The cleaning formulation of claim 1 wherein said fluoride source comprises a fluoride species selected from the group consisting of:

ammonium fluoride; and

triethanolammonium fluoride (TEAF).

3. (Original) The cleaning formulation of claim 1 wherein said organic amine(s) comprise an amine selected from the group consisting of:

diglycolamine (DGA),

methyldiethanolamine (MDEA),

pentamethyldiethylenetriamine (PMDETA),

triethanolamine (TEA), and

triethylenediamine (TEDA).

4. (Currently Amended) The cleaning formulation of claim 1 wherein said nitrogenous component ~~comprises~~ includes a species selected from the group consisting of:

iminodiacetic acid (IDA);
glycine;
nitrilotriacetic acid (NTA); and
1,1,3,3-tetramethylguanidine (TMG).

5. (Original) The cleaning formulation of claim 1 including at least one metal chelating agent selected from the group consisting of:

acetoacetamide,
ammonium carbamate,
ammonium pyrrolidinedithiocarbamate (APDC),
dimethyl malonate,
methyl acetoacetate,
N-methyl acetoacetamide,
2,4-pentanedione,
tetramethylammonium thiobenzoate,
tetramethylammonium trifluoroacetate, and
tetramethylthiuram disulfide (TMTDS).

6. (Original) The cleaning formulation of claim 1 wherein said fluoride source comprises a species selected from the group consisting of:

ammonium fluoride,

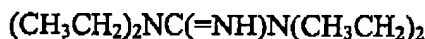
triethanolammonium fluoride (TEAF),
diglycolammonium fluoride (DGAF),
tetramethylammonium fluoride (TMAF), and
triethylamine tris (hydrogen fluoride) (TREAT-HF).

7. (Original) The cleaning formulation of claim 1 wherein said organic amine(s) comprises an amine selected from the group consisting of:

diglycolamine (DGA),
methyldiethanolamine (MDEA),
pentamethyldiethylenetriamine (PMDETA),
triethanolamine (TEA),
triethylenediamine (TEDA),
hexamethylenetetramine,
3, 3-iminobis (N,N-dimethylpropylamine), and
monoethanolamine.

8. (Currently Amended) The cleaning formulation of claim 1, wherein said nitrogenous component ~~comprises~~ includes a species from the group consisting of:

iminodiacetic acid (IDA)
glycine
nitrilotriacetic acid (NTA)
1,1,3,-tetramethylguanidine (TMG)
 $\text{CH}_3\text{C}(=\text{NCH}_2\text{CH}_2\text{OH})\text{CH}_2\text{C}(\text{O})\text{N}(\text{CH}_3)_2$



9. (Original) The cleaning formulation of claim 1 wherein said fluoride source comprises a species selected from the group consisting of:

Ammonium fluoride,

triethanolammonium fluoride (TEAF),

diglycolammonium fluoride (DGAF),

tetramethylammonium fluoride (TMAF), and

triethylamine tris (hydrogen fluoride) (TREAT-HF);

said organic amine(s) comprise a species selected from the group consisting of:

diglycolamine (DGA),

methyldiethanolamine (MDEA),

pentamethyldiethylenetriamine (PMDETA),

triethanolamine (TEA),

triethylenediamine (TEDA),

hexamethylenetetramine,

3, 3'-iminobis (N,N-dimethylpropylamine), and

monoethanolamine;

said nitrogenous component comprises a species selected from the group consisting of:

iminodiacetic acid (IDA)

glycine

nitrilotriacetic acid (NTA)

1,1,3,3-tetramethylguanidine (TMG)

and said formulation includes a metal chelating agent comprising a species selected from the group consisting of:

acetoacetamide,

ammonium carbamate,

ammonium pyrrolidinedithiocarbamate (APDC),

dimethyl malonate,

methyl acetoacetate,

N-methyl acetoacetamide,

2,4-pentanedione,

tetramethylammonium thiobenzoate,

tetramethylammonium trifluoroacetate, and

tetramethylthiuram disulfide (TMTDS).

10. (Original) The cleaning formulation of claim 1 wherein said fluoride source comprises a compound having the general formula $R_1R_2R_3R_4NF$ in which each of the R groups is independently selected from hydrogen atoms and aliphatic groups, and wherein said formulation includes a metal chelating agent of the formula:

X-CHR-Y, in which

R is either hydrogen or an aliphatic group and

X and Y are functional groups containing multiply bonded moieties having electron-withdrawing properties.

11. (Original) The cleaning formulation of claim 10 wherein each of X and Y is independently selected from CONH_2 , CONHR' , CN , NO_2 , SOR' , and SO_2Z in which R' is alkyl and Z is hydrogen, halo, or alkyl.

12. (Original) The cleaning formulation of claim 1 wherein said fluoride source comprises a compound having the formula $\text{R}_1\text{R}_2\text{R}_3\text{R}_4\text{NF}$ in which each of the R groups is hydrogen or aliphatic, and wherein said formulation includes a metal chelating agent of the formula, $\text{R}_1\text{R}_2\text{R}_3\text{R}_4\text{N}^+\text{O}_2\text{CCF}_3$ in which each of the R groups is independently hydrogen or aliphatic.

13. (Presently Canceled) The cleaning formulation of claim 1, wherein said nitrogenous component includes a compound having the formula:



wherein each of R and R' is independently selected from the group consisting of hydrogen, alkyl, aryl, and carboxylic acids.

14. (Original) A method for fabricating a semiconductor wafer, comprising:
plasma etching a metalized layer from a surface of the wafer;
plasma ashing a resist from the surface of the wafer;

cleaning the wafer by contacting same with a cleaning formulation, comprising the following components in the percentage by weight ranges shown, based on the total weight of such components:

fluoride source	1-21%
organic amine(s)	20-55%
a nitrogenous component, selected from nitrogen-containing	
carboxylic acids and imines	0.5-40%
water	23-50%
<u>metal chelating agent(s)</u>	<u>0-21%</u>
TOTAL	100%

15. (Original) The method of claim 14 wherein said fluoride source comprises a fluoride species selected from the group consisting of:

ammonium fluoride; and

triethanolammonium fluoride (TEAF).

16. (Original) The method of claim 14 wherein said organic amine(s) comprise an amine selected from the group consisting of:

diglycolamine (DGA),

methyldiethanolamine (MDEA),

pentamethyldiethylenetriamine (PMDETA),

triethanolamine (TEA), and

triethylenediamine (TEDA).

17. (Original) The method of claim 14 wherein said nitrogenous component comprises a species selected from the group consisting of:

iminodiacetic acid (IDA);

glycine;

nitrilotriacetic acid (NTA); and

1,1,3,3-tetramethylguanidine (TMG).

18. (Original) The method of claim 14 including at least one metal chelating agent selected from the group consisting of:

acetoacetamide,

ammonium carbamate,

ammonium pyrrolidinedithiocarbamate (APDC),

dimethyl malonate,

methyl acetoacetate,

N-methyl acetoacetamide,

2,4-pentanedione,

tetramethylammonium thiobenzoate,

tetramethylammonium trifluoroacetate, and

tetramethylthiuram disulfide (TMTDS).

19. (Original) The method of claim 14 wherein said fluoride source comprises a species selected from the group consisting of:

ammonium fluoride,
triethanolammonium fluoride (TEAF),
diglycolammonium fluoride (DGAF),
tetramethylammonium fluoride (TMAF), and
triethylamine tris (hydrogen fluoride) (TREAT-HF).

20. (Original) The method of claim 14 wherein said organic amine(s) comprises an amine selected from the group consisting of:

diglycolamine (DGA),
methyldiethanolamine (MDEA),
pentamethyldiethylenetriamine (PMDETA),
triethanolamine (TEA),
triethylenediamine (TEDA),
hexamethylenetetramine,
3, 3-iminobis (N,N-dimethylpropylamine), and
monoethanolamine.

21. (Original) The method of claim 14, wherein said nitrogenous component comprises a species from the group consisting of:

iminodiacetic acid (IDA)

glycine

nitrilotriacetic acid (NTA)

1,1,3,-tetramethylguanidine (TMG)

$\text{CH}_3\text{C}(=\text{NCH}_2\text{CH}_2\text{OH})\text{CH}_2\text{C}(\text{O})\text{N}(\text{CH}_3)_2$

$\text{CH}_3\text{C}(=\text{NCH}_2\text{CH}_2\text{OCH}_2\text{CH}_2\text{OH})\text{CH}_2\text{C}(\text{O})\text{N}(\text{CH}_3)_2$

$\text{CH}_3\text{C}(=\text{NH})\text{CH}_2\text{C}(\text{O})\text{CH}_3$

$(\text{CH}_3\text{CH}_2)_2\text{NC}(=\text{NH})\text{N}(\text{CH}_3\text{CH}_2)_2$

$\text{HOOCCH}_2\text{N}(\text{CH}_3)_2$

$\text{HOOCCH}_2\text{N}(\text{CH}_3)\text{CH}_2\text{COOH}$

22. (Original) The method of claim 14 wherein said fluoride source comprises a species selected from the group consisting of:

ammonium fluoride,

triethanolammonium fluoride (TEAF),

diglycolammonium fluoride (DGAF),

tetramethylammonium fluoride (TMAF), and

triethylamine tris (hydrogen fluoride) (TREAT-HF);

said organic amine(s) comprise a species selected from the group consisting of:

diglycolamine (DGA),

methyldiethanolamine (MDEA),

pentamethyldiethylenetriamine (PMDETA),

triethanolamine (TEA),

triethylenediamine (TEDA),

hexamethylenetetramine,

3, 3-iminobis (N,N-dimethylpropylamine), and

monoethanolamine;

said nitrogenous component comprises a species selected from the group consisting of:

iminodiacetic acid (IDA)

glycine

nitrilotriacetic acid (NTA)

1,1,3,3-tetramethylguanidine (TMG)

and said formulation includes a metal chelating agent comprising a species selected from the group consisting of:

acetoacetamide,

ammonium carbamate,

ammonium pyrrolidinedithiocarbamate (APDC),

dimethyl malonate,

methyl acetoacetate,

N-methyl acetoacetamide,

2,4-pentanedione,

tetramethylammonium thiobenzoate,

tetramethylammonium trifluoroacetate, and

tetramethylthiuram disulfide (TMTDS).

23. (Original) The method of claim 14 wherein said fluoride source comprises a compound having the general formula $R_1R_2R_3R_4NF$ in which each of the R groups is

independently selected from hydrogen atoms and aliphatic groups, and wherein said formulation includes a metal chelating agent of the formula:

X-CHR-Y, in which

R is either hydrogen or an aliphatic group and

X and Y are functional groups containing multiply bonded moieties having electron-withdrawing properties.

24. (Original) The method of claim 23 wherein each of X and Y is independently selected from CONH₂, CONHR', CN, NO₂, SOR', and SO₂Z in which R' is alkyl and Z is hydrogen, halo, or alkyl.

25. (Original) The method of claim 14 wherein said fluoride source comprises a compound having the formula R₁R₂R₃R₄NF in which each of the R groups is hydrogen or aliphatic, and wherein said formulation includes a metal chelating agent of the formula, R₁R₂R₃R₄N⁺·O₂CCF₃ in which each of the R groups is independently hydrogen or aliphatic.

26. (Original) The method of claim 14, wherein said nitrogenous component includes a compound having the formula:

COOH-CH₂-NRR'

wherein each of R and R' is independently selected from the group consisting of hydrogen, alkyl, aryl, and carboxylic acids.

27. (Original) A method for fabricating a semiconductor wafer including the steps comprising:

plasma etching a metalized layer from a surface of the wafer;

plasma ashing a resist from the surface of the wafer;

cleaning the wafer by contacting same with a cleaning formulation, comprising the following components in the percentage by weight ranges shown, based on the total weight of such components:

a fluoride source;	1-21%
at least one organic amine;	20-55%
a nitrogen-containing carboxylic acid or imine	0.5-40%
water;	23-50%
<u>at least one metal chelating agent</u>	<u>0-21%</u>
TOTAL	100%

28. (Original) The method of claim 27 wherein said fluoride source is chosen from the group consisting of:

ammonium fluoride; and

triethanolammonium fluoride (TEAF).

29. (Original) The method of claim 27 wherein said organic amine is chose from the group consisting of:

diglycolamine (DGA),

methyldiethanolamine (MDEA),

pentamethyldiethylenetriamine (PMDETA),

triethanolamine (TEA), and

triethylenediamine (TEDA).

30. (Original) The method of claim 27 wherein said nitrogen-containing carboxylic acid or imine is selected from the group consisting of:

iminodiacetic acid (IDA)

glycine

nitilotriacetic acid (NTA)

1,1,3,3-tetramethylguanidine (TMG)

31. (Original) The method of claim 27 wherein said metal chelating agent is selected from the group consisting of:

acetoacetamide,

ammonium carbamate,

ammonium pyrrolidinedithiocarbamate (APDC),

dimethyl malonate,

methyl acetoacetate,

N-methyl acetoacetamide,

2,4-pentanedione,

tetramethylammonium thiobenzoate,

tetramethylammonium trifluoroacetate, and

tetramethylthiuram disulfide (TMTDS).

32. (Original) The method of claim 27 wherein said fluoride source is selected from the group consisting of:

ammonium fluoride,
triethanolammonium fluoride (TEAF),
diglycolammonium fluoride (DGAF),
tetramethylammonium fluoride (TMAF), and
triethylamine tris (hydrogen fluoride) (TREAT-HF).

33. (Original) The method of claim 27 wherein said organic amine is selected from the group consisting of:

diglycolamine (DGA),
methyldiethanolamine (MDEA),
pentamethyldiethylenetriamine (PMDETA),
triethanolamine (TEA),
triethylenediamine (TEDA),
hexamethylenetetramine,
3, 3-iminobis (N,N-dimethylpropylamine), and
monoethanolamine.

34. (Original) The method of claim 27, wherein said nitrogen-containing carboxyl acid or imine is selected from the group consisting of:

iminodiacetic acid (IDA)

glycine

nitrilotriacetic acid (NTA)

1,1,3,-tetramethylguanidine (TMG)

$\text{CH}_3\text{C}(=\text{NCH}_2\text{CH}_2\text{OH})\text{CH}_2\text{C}(\text{O})\text{N}(\text{CH}_3)_2$

$\text{CH}_3\text{C}(=\text{NCH}_2\text{CH}_2\text{OCH}_2\text{CH}_2\text{OH})\text{CH}_2\text{C}(\text{O})\text{N}(\text{CH}_3)_2$

$\text{CH}_3\text{C}(=\text{NH})\text{CH}_2\text{C}(\text{O})\text{CH}_3$

$(\text{CH}_3\text{CH}_2)_2\text{NC}(=\text{NH})\text{N}(\text{CH}_3\text{CH}_2)_2$

$\text{HOOCCH}_2\text{N}(\text{CH}_3)_2$

$\text{HOOCCH}_2\text{N}(\text{CH}_3)\text{CH}_2\text{COOH}$

35. (Original) The method of claim 27 wherein said fluoride source is selected from the group consisting of:

ammonium fluoride,

triethanolammonium fluoride (TEAF),

diglycolammonium fluoride (DGAF),

tetramethylammonium fluoride (TMAF), and

triethylamine tris (hydrogen fluoride) (TREAT-HF);

said organic amine is chosen from the group consisting of:

diglycolamine (DGA),

methyldiethanolamine (MDEA),

pentamethyldiethylenetriamine (PMDETA),

triethanolamine (TEA),

triethylenediamine (TEDA),
hexamethylenetetramine,
3, 3-iminobis (N,N-dimethylpropylamine), and
monoethanolamine;

said nitrogen-containing carboxylic acid or imine is chosen from the group consisting of:

iminodiacetic acid (IDA)
glycine
nitrilotriacetic acid (NTA)
1,1,3,3-tetramethylguanidine (TMG)

and said metal chelating agent is selected from the group consisting of:

acetoacetamide,
ammonium carbamate,
ammonium pyrrolidinedithiocarbamate (APDC),
dimethyl malonate,
methyl acetoacetate,
N-methyl acetoacetamide,
2,4-pentanedione,
tetramethylammonium thiobenzoate,
tetramethylammonium trifluoroacetate, and
tetramethylthiuram disulfide (TMTDS).

36. (Original) The method of claim 27 wherein said fluoride source comprises a compound having the formula $R_1R_2R_3R_4NF$ in which each of the R groups is hydrogen atoms or aliphatic, and wherein said metal chelating agent has the formula:

$X-CHR-Y$, in which

R is either hydrogen or an aliphatic group, and

X and Y are functional groups containing multiply-bonded moieties having electron-withdrawing properties.

37. (Original) The method of claim 27 wherein said fluoride source comprises a compound having the formula $R_1R_2R_3R_4NF$ in which each of the R groups is hydrogen or aliphatic, and wherein said metal chelating agent has the formula, $R_1R_2R_3R_4N^+ O_2CCF_3$ in which each of the R groups is hydrogen or aliphatic.

38. (Original) The method of claim 27, wherein said nitrogen-containing carboxylic acid has the formula:

$COOH-CH_2-NRR'$

wherein each of R and R' is independently selected from the group consisting of hydrogen, alkyl, aryl, and carboxylic acid.

39. (Original) A method of removing residue from a wafer following a resist plasma ashing step on said wafer, comprising contacting the wafer with a cleaning formulation, including (i) a fluoride source, (ii) at least one organic amine, (iii) a nitrogen-containing carboxylic acid or an imine, (iv) water, and optionally at least one metal chelating agent.

40. (Currently Canceled) A wafer cleaning formulation, including (i) a fluoride source, (ii) at least one organic amine, (iii) a nitrogen-containing carboxylic acid or an imine, (iv) water, and a metal chelating agent.